PLANT ITEM MATERIAL SELECTION DATA SHEET

R10682509

CNP-HX-00002 (PTF)
Cs Evaporator Primary Condenser

- Design Temperature (°F)(max/min): Shell side: 250/40; Tube side: 125/40
- Design Pressure (psig) (max/min): Shell side: 50/FV; Tube side: 100/FV
- Location: outcell

ISSUED BY
RPP-WTP PDC

Design temperature and pressure information is considered bounding and to be confirmed by Vendor.

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- Normal operations

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: Shell side and tube side: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- None

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EXPIRES: 12/07/07

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This bound document contains a total of 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	5/25/06	Issued for Permitting Use			
0	9/8/04	Issued for Permitting Use	DLA	JRD	APR

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Corrosion Considerations:

CNP-HX-00002 is a water-cooled, U-tube unit with condensation taking place on the shell side. Product flow includes excess water from the pre-elution and post-elution rinses from the ion exchange columns.

a General Corrosion
In normal operation, the vessel will contain either treated process water (slightly acidic) or DIW. Based on Uhlig (1948), little uniform corrosion is expected at these conditions. The uniform corrosion rate of the 300 series stainless steels in DIW at temperatures up to about boiling are generally considered small, <1 mpy. Hamner (1981) lists a corrosion rate for 304 (and 304L) in pure water of less than 2 mpy (his smallest unit of measurement).

Conclusion:
304L or 316L are acceptable for this system with a probable general corrosion rate of less than 1 mpy.

b Pitting Corrosion
With the proposed temperatures, 304L is acceptable under the stated no-chloride conditions.

Conclusion:
The data suggest there are no halides to cause pitting, 304L is recommended.

c End Grain Corrosion
Not believed to be applicable to this system.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140 °F. Further, the use of "L" grade stainless reduces the opportunity for sensitization.

Conclusion:
The use of 304L is expected to be acceptable for the stated no-chloride conditions.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting

f Corrosion at Welds
Corrosion at welds is not a problem in the proposed environment.

Conclusion:
Weld corrosion is not a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are potentially suitable for MIC. However, MIC is not normally observed in operating systems.

Conclusion:
MIC will not be a problem.

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h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a concern.

Conclusion:
Not applicable.

i Vapor Phase Corrosion
Not applicable to this system.

Conclusion:
Vapor phase corrosion is not expected.

j Erosion
There are no solids and the velocities are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
None expected.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not applicable.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
The contents of the condenser are essentially water with no reportable halides. The lowering of the pH by the inadvertent addition of nitric acid would be of no concern.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of nitric acid.

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References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation of Stainless Steel Wear Rates in WTP Waste Streams at Low Velocities,*
2. 24590-WTP-RPT-PR-04-0001, Rev. B, *WTP Process Corrosion Data*
3. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
4. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX
5. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
6. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158

Bibliography:

1. CCN 130170, Blackburn, LD to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Evaluation of 240-AR Chloride Limit*, August 15, 1991.
2. CCN 130171, Ohl, PC to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Technical Bases for Cl- and pH Limits for Liquid Waste Tank Cars*, MA: PCO:90/01, January 16, 1990.
3. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
4. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218
7. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

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24590-WTP-RPT-PR-04-0001, Rev. B
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Cs evaporator primary, inter- and after- condenser (CNP-HX-00002,3,4)

Facility PTF

In Black Cell? No

Chemicals	Unit[1]	Contract Max		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/m^3					
Chloride	g/m^3					
Fluoride	g/m^3					
Iron	g/m^3					
Nitrate	g/m^3					
Nitrite	g/m^3					
Phosphate	g/m^3					
Sulfate	g/m^3					
Mercury	g/m^3					
Carbonate	g/m^3					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/m^3					
Other	g/m^3					
pH	N/A					Assumption 1
Temperature	°F					Assumption 2

List of Organic Species:

References

System Description: 24590-PTF-3YD-CNP-00001, Rev 0
Mass Balance Document: Chemical Max Calculation 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: CNP04
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: N/A
PFD: 24590-PTF-M5-V17T-P0014, Rev 1
Technical Reports: N/A

Notes:

1. Concentrations less than 1x 10^{-4} g/m^3 do not need to be reported; list values to two significant digits max.

Assumptions:

1. The overheads from the distillation column are expected to be contain primarily water with pH near or at 7.0.
2. Assume same as T normal operation for the evaporator, 122 °F to 212 °F (pressure of operation for last condenser is atmospheric)

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4.1.5 Cs Evaporator Primary Condenser (CNP-HX-00002), Cs Evaporator Inter-Condenser (CNP-HX-00003), and Cs Evaporator After-Condenser (CNP-HX-00004)

Routine Operations

The Cs evaporator primary condenser, CNP-HX-00002, is a water-cooled, U-tube unit with condensation taking place on the shell side. The condenser shell incorporates a condensate sump, which contains a weir arrangement to control the flow split between the reflux and the overhead product flows. The overhead product flow includes excess water from the pre-elution and post-elution rinses sent to the Cs evaporator separator vessel from the cesium ion exchange columns.

To reduce the boiling temperature of the liquids in the Cs evaporator separator vessel, the system is run under vacuum. This is achieved using a two-stage steam ejector system. Exhaust vapors from the ejectors are condensed in Cs evaporator inter-condenser, CNP-HX-00003, and after-condenser, CNP-HX-00004, prior to venting to the ventilation system scrubbing equipment. Process condensate from the Cs evaporator primary condenser and Cs evaporator secondary condenser drains to the acidic/alkaline effluent vessels, PWD-VSL-00015 and PWD-VSL-00016, located in the PWD system.

The condensate from the condensers has a minimal amount of HNO_3, making it slightly acidic but not acidic enough to warrant neutralization; thus, it will be considered and referred to as process condensate.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.